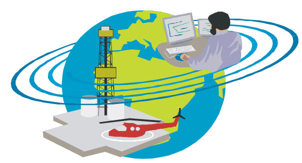

APPENDIX G:

Calculations of Monthly Inflow Volumes

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APPENDIX G

Calculation of Monthly Inflow Volumes
for Alternative Water Management Strategies for Stillwater Marsh,
Presented in the Stillwater National Wildlife Refuge Complex Comprehensive
Conservation Plan and Boundary-Revision Environmental Impact Statement

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February, 2002

INTRODUCTION

The purpose of this report is to provide background information on the modeled monthly Stillwater NWR wetland inflow volumes of each alternative evaluated in the environmental impact statement (EIS) for the Stillwater National Wildlife Refuge (NWR) Complex comprehensive conservation plan and boundary revision (CCP EIS). This report explains the basis for and assumptions of each alternative seasonal pattern of inflow and outlines the steps used in calculating monthly inflow volumes of deliverable water and incidental flows for each alternative. All alternative water budgets are based on sources identified in Alternative 5 of the Final Environmental Impact Statement for Water Rights Acquisition for Lahontan Valley Wetlands and its associated Record of Decision (WRAP EIS and ROD; U.S. Fish and Wildlife Service 1996a, 1996b).

This report integrates materials from Appendices H and I of the Draft CCP EIS. Appendix H explained how annual and monthly flow volumes for each alternative were derived. Appendix I outlined the methods and results of a Stillwater Marsh Inflow and Acreage Model, which provided a mechanism to estimate wetland acreage as a function of differing annual and monthly water inflow volumes of each alternative. The model in Appendix I combined current Stillwater Marsh wetland units into complexes, which were flooded by a relative proportion of 85% of water entering from the south end of the refuge (Stillwater Point Reservoir) and 15% from the west end (Lead Lake). Individual wetland complexes were treated as “bowls” which once filled, would spill over to the next wetland complex until all wetland units were flooded. Excess water continued out into the Big Water unit at the southeast corner of the Carson Sink. The model simulated elements of current hydrology of the marsh (e.g., existing flow pathways), and provided the Service with an analytical tool to objectively compare CCP EIS Alternative water management strategies.

For the Final CCP EIS, the Below Lahontan Reservoir (BLR) Model and attached Truckee River Operations Model (TROM; Yardas and Robertson 1996) were used to estimate annual and monthly wetland habitat acreage resulting from each alternative because 1) they increased the capacity for a more robust data analysis (i.e., 95 year hydrologic period); 2) multiple parameters in the Truckee and Carson River systems can be compared using the same output; and 3) the estimates of wetland habitat acreage are directly linked to the model that generated estimates of annual and monthly inflows to Stillwater NWR. These models cannot be used to predict individual future year conditions nor can they be compared with past years operations. However, they are the best available tools for comparing differences among broad management alternatives, and to allow for direct comparison with other analyses performed for this Final CCP EIS. Use of the Stillwater Marsh Model was discontinued for the purposes of estimating annual and monthly wetland habitat acreages.

The BLR Model also treats the Stillwater Marsh as a "bowl" which must be filled before it spills over to the Carson Sink. Similar to the Stillwater Marsh Model, the BLR Model evaluates water movement relative to long-term average monthly evapotranspiration rates, but also examines other water loss parameters associated with water delivery such as efficiency of off refuge delivery canals and groundwater seepage losses.

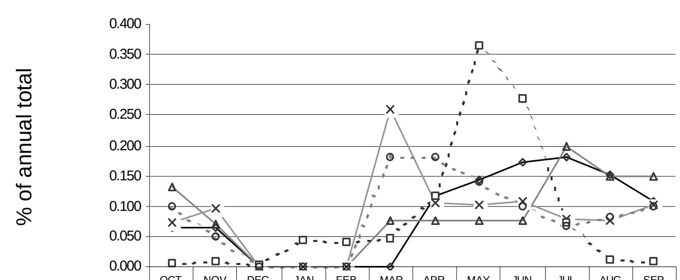
For the purposes of this report, all water years were combined within the 95-year hydrologic period assessed by the BLR model. Spill years and non-spill years were not analyzed separately. A qualitative discussion of water management strategies which could be implemented in drought, normal, and spill years was retained in the following discussion; however, all quantitative assessments examine long-term average wetland acreage and Carson Division flow dynamics throughout the range of conditions prevalent during the BLR Model, 95 year period of analysis.

BASIS OF MONTHLY WATER DISTRIBUTION PERCENTAGES

Overview of Alternative Specific, Monthly Water Distribution Percentages

Each alternative was developed to achieve a specific, desired future condition based on elements of habitat representation and the seasonal needs of waterbirds. Alternative A is the baseline for comparison for action Alternatives B through E and is representative of past agricultural delivery patterns within the Carson Division of the Newlands Project. Alternative B represents an approach to maximize habitat availability for fall and wintering waterfowl with assumed habitat carryover to allow for spring migration as well. Alternative C represents an approach to approximate natural conditions in Stillwater Marsh, and emphasizes the approximation of natural ecological processes such as flushing spring flows, while minimizing nest flooding and providing additional fall habitat. Alternative D focuses on the restoration of the historic monthly inflow percentages, based on estimated proportional monthly flow if the Newlands Project were

Figure 1: Monthly prime water allocation percentages used in modeling analyses for all Alternatives.

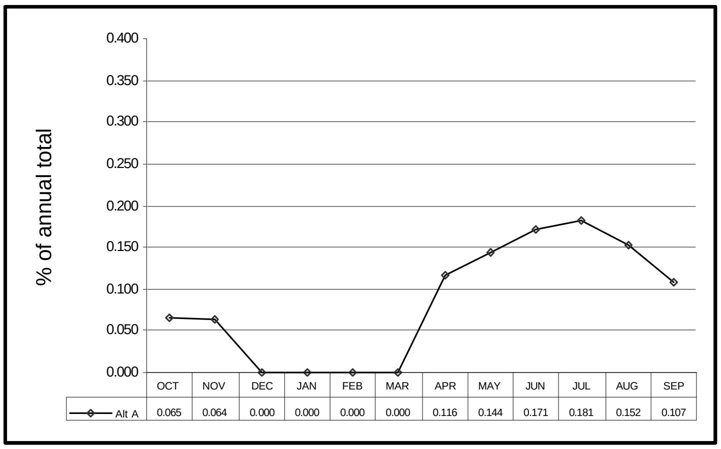


	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Alt A	0.065	0.064	0.000	0.000	0.000	0.000	0.116	0.144	0.171	0.181	0.152	0.107
Alt B	0.130	0.070	0.000	0.000	0.000	0.075	0.075	0.075	0.075	0.200	0.150	0.150
Alt C	0.072	0.095	0.000	0.000	0.000	0.260	0.105	0.102	0.107	0.080	0.077	0.102
Alt D	0.005	0.010	0.004	0.043	0.040	0.047	0.118	0.364	0.277	0.072	0.012	0.008
Alt E	0.100	0.050	0.000	0.000	0.000	0.180	0.180	0.140	0.100	0.067	0.083	0.100

not in place, as an approach to restore the marsh's natural biological diversity. Similar to Alternative C, Alternative E was designed to account for significant reduction in volume of inflow and to provide more flexibility within broad seasonal flow percentages. Modifications to seasonal allocation percentages under this alternative were designed to provide a wider range of delivery flexibility during the different seasons (spring, summer, and fall) to allow for management adaptation based on availability of water, habitat response during the growing season relative to habitat objectives, and the seasonal requirements of different waterbird guilds. The average monthly alternative inflow-percentages used in modeling analyses are presented in Figure 1.

Basis of Alternative A Seasonal Pattern of Inflow Volume

Figure 2: Monthly prime water allocation percentages used in modeling analysis for Baseline Alternative A.



The agricultural seasonal delivery pattern for the Carson Division was used for Alternative A. In spill years, this would be adjusted to account for the large influx of spill-water early in the year. Generally, delivery of prime water would be delayed until later in the season. Seasonal allocation patterns for Alternative A are presented in the following table while monthly percentages for BLR modeling purposes are presented in Figure 2.

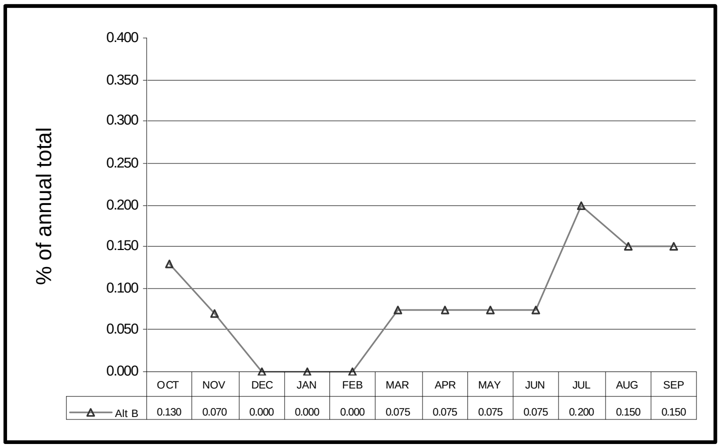
	Dec-Feb	Mar-Jun	Jul-Sep	Oct-Nov
Low water-year	0%	40-55%	40-55%	10-15%
Full water-year	0%	40-50%	40-50%	10-15%
Spill year	0%	20-40%	50-60%	20-40%

Basis of Alternative B Seasonal Pattern of Inflow Volume

The pattern of inflow used in Alternative B would maximize the amount of fall/winter wetland habitat. Under this scenario, raising water levels in wetland units would be delayed until after the highest period of evapotranspiration (June-August). Beginning later in September, when air temperatures lower and day length shortens sufficiently to reduce evapotranspiration, less water is required to fill and maintain units than would be required one or two months prior. Nevertheless, a considerable amount of water would be needed in late summer and early fall to bring wetland units up to desired levels. However, once these levels are reached, maintenance at these levels or slow increases in water level would take relatively little water due to low evapotranspiration rates during November-January. Because peak annual acreage would be maintained during the least costly period, this scenario would require the least amount of water to maintain the targeted annual average wetland habitat acreage.

Without supplemental inflow in addition to drainwater, wetland habitat acreage would begin declining fairly rapidly in May. Therefore, rather than using all of the available deliverable water for the fall and winter period, a portion of water was dedicated for spring use to maintain at least some wetland habitat through this season. Additional water was dedicated for summer use to maintain some brooding habitat and to start the late summer increase in wetland habitat acreage at a somewhat higher level.

Figure 3: Monthly prime water allocation percentages used in modeling analysis for action Alternative B.



In spill years, monthly water delivery amounts would be adjusted to account for the large influx of spill water early in the year by “saving” additional water for late summer and fall deliveries. The seasonal pattern of drainwater and groundwater inflow would not be adjusted during spill years. Seasonal allocation patterns are presented in the following table while monthly percentages for BLR modeling purposes are presented in Figure 3.

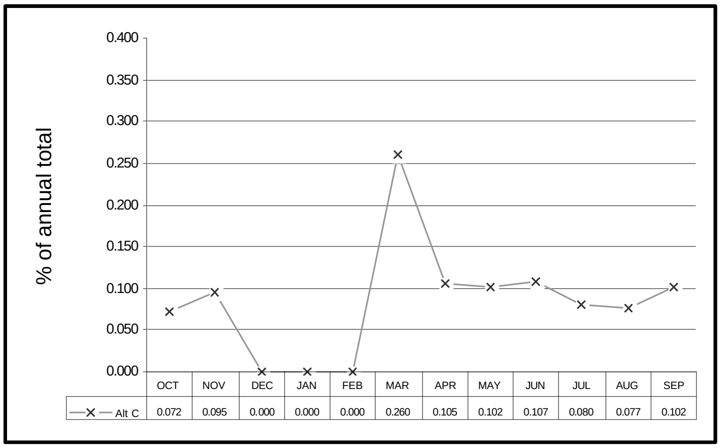
	Dec-Feb	Mar-Jun	Jul-Sep	Oct-Nov
Low water-year	0%	0-20%	50-70%	20-40%
Full water-year	0%	20-40%	40-60%	10-30%
Spill year	0%	0-40%	50-70%	20-40%

Basis of Alternative C Seasonal Pattern of Inflow Volume

Alternative C’s pattern of inflow was developed to emphasize a natural seasonal inflow pattern and the associated large volume of fresh water entering the marsh during the spring. Using Alternative D’s pattern as a starting point, the Alternative C strategy was modified to minimize nest flooding and to produce more fall/winter wetland habitat than would be produced under Alternative D. Because the peak water inflow would occur during April-June under Alternative D (peaking in May), extensive nest flooding could occur each year. To alleviate this detrimental affect, the peak flow was moved back to March so that maximum acreages would be obtained before the period of major nest initiation for many wetland bird species.

Another modification made to the natural seasonal inflow pattern under this alternative is the increased volume of water that would be shifted to late summer and fall (i.e., shifts the pattern toward Alternative B). There are three reasons for this: (1) under natural conditions, much wetland habitat would have remained in Stillwater Marsh through the fall and winter in many years (valley wide, the amount would have been consistently high, even in drought years); (2) Stillwater Marsh is an important stopover and wintering area for many species of waterfowl; and (3) waterfowl hunting is the largest public use component of Stillwater Marsh and hunters have expressed great interest in the Fish and Wildlife Service providing opportunities for waterfowl hunting. Regarding the first point, Alternative C appears to allow a more representative seasonal pattern of wetland-habitat acres to be sustained than would occur under Alternative D. In this alternative, substantial wetland habitat would be sustained through the fall and winter, but would dedicate a majority of available water to mimicking a spring-time surge in wetland inflow.

Figure 4: Monthly prime water allocation percentages used in modeling analysis for action Alternative C.



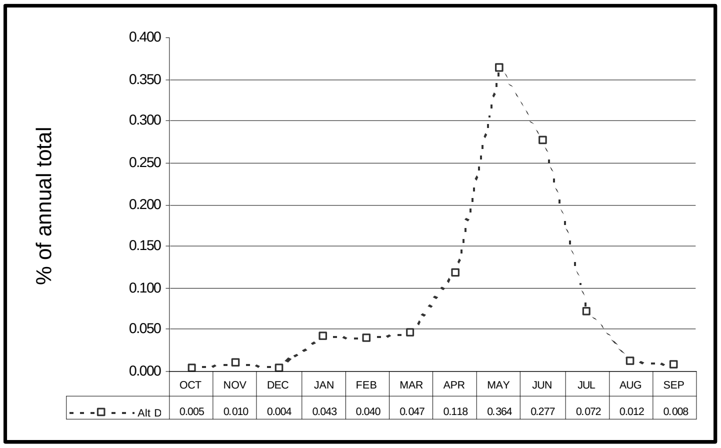
In spill years, the monthly inflow of deliverable water was adjusted to account for the large influx of spill water early in the year. Generally, delivery of deliverable water would be held off until later in the season. Seasonal pattern of drainwater and groundwater inflow would not be adjusted during spill years. Seasonal allocation patterns are presented in the following table while monthly percentages for BLR modeling purposes are presented in Figure 4.

	Dec-Feb	Mar-Jun	Jul-Sep	Oct-Nov
Low water-year	0%	50-80%	0-30%	0-15%
Full water-year	5-10%	50-70%	20-30%	10-15%
Spill year	0-10%	30-60%	20-40%	10-30%

Basis of Alternative D's Seasonal Pattern of Inflow Volume

Alternative D's seasonal pattern of inflow mimics the natural hydrologic inflow pattern for Stillwater Marsh. This pattern is being evaluated because one of the fundamental principles of restoring natural biological diversity is to restore ecological processes to their natural level and pattern of operation (Noss and Cooperider 1994, Doppelt et al. 1993). Except in years when floods occurred due to rain on Sierra snowpack between November and April, the seasonal proportion of inflow appears to have been consistent among years under natural conditions. Carson River runoff from April through June consistently accounted for approximately 40 to 60 percent of the total annual flow (DeLong 1997). During July-September, up to 10 to 15 percent of the annual flow of the Carson River would have entered the Lahontan Valley wetlands. Inflow from October to December accounted for 5 to 10 percent of the annual inflow into the Lahontan Valley, and in January to March, inflow would have consistently been 10 to 20 percent in most nonflood years.

Figure 5: Monthly prime water allocation percentages used in modeling analysis for action Alternative D.



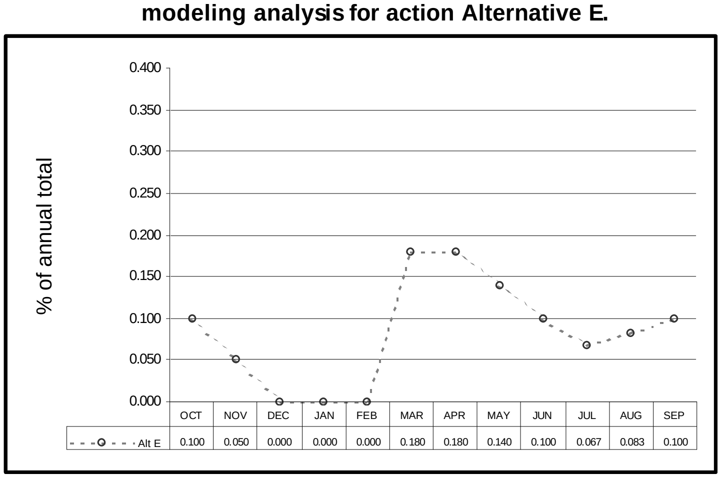
In spill years, the monthly pattern of deliverable water inflow would be adjusted to account for the large influx of spill water early in the year. Seasonal allocation patterns are presented in the following table and monthly percentages for BLR modeling purposes are presented in Figure 5.

	Dec-Feb	Mar-Jun	Jul-Sep	Oct-Nov
Low water-year	0-15%	70-100%	0-10%	0-10%
Full water-year	5-15%	70-90%	5-15%	0-10%
Spill year	10-30%	60-90%	5-10%	0-5%

Basis of Alternative E Seasonal Pattern of Inflow Volume

Alternative E was patterned after the Alternative C water management strategy with a few modifications. First, the staging of seasonal allocation patterns was adjusted to reflect an increase in the maximum amount to be delivered during fall (Oct-Nov) in a full water year (adjusted from 10-15% to 10-25%) to allow flexibility to more adequately meet the needs of fall migrating and wintering waterbirds. Second, the Service has identified interim strategies to implement spring hydration schedules so that the spring pulse would not be implemented unless the refuge has 20,000 acre-feet of deliverable water in a given year, and then up to 21% of the refuge's total available water (30% of the maximum March through June allocation) would be delivered from March 15 to April 1. Third, the Service would implement the spring pulse in one of four identified flow corridors (chain of 3-5 connected wetland units), while stabilizing water in two others and allowing for a slow drawdown in the fourth. And finally, the Service would implement adaptive management in low water years, using management objectives, the existing condition of habitat in

Figure 6: Monthly prime water allocation percentages used in modeling analysis for action Alternative E.



wetland units, and the available water in a given year and/or the predicted availability of water in Lahontan Reservoir as the key elements in which to base water allocation strategies. Adaptive management under Alternative E would include the use of any of the seasonal allocation patterns described under the previous action alternatives in a given low water year. Seasonal allocation patterns are presented in the following table and monthly percentages for BLR modeling purposes are presented in Figure 6.

	Dec-Feb	Mar-Jun	Jul-Sep	Oct-Nov
Low water-year	0%	- - Adaptive Management Strategies[1] - -		
Full water-year	0%	50-70%	20-30%	10-25%
Spill year	0%	30-60%	20-40%	10-30%

Possible water management strategies which could be applied, singly or in combination, under Alternative E's adaptive management approach in low water conditions include:

1. A spring emphasis to ensure that Stillwater NWR receives its share of the allocated water percentage prior to the early conclusion of the irrigation season. This could result in low acreage of wetland habitat for fall migratory and wintering waterbirds later in the water year but would be favorable for spring migratory and breeding waterbirds.

2. A fall emphasis to provide habitat for migrating and wintering waterbirds. Little habitat for breeding populations may result from this strategy, and there is the potential that the irrigation season will end prior to receiving entitlement.

3. The agricultural delivery pattern which would provide habitat for breeding populations and habitat for migratory and wintering populations, but would not optimize conditions during either period.

Adaptive management recognizes that wetland management is both an art and a science. It requires frequent on-the-ground assessments of progress toward meeting management objectives as the growing season commences, in combination with long-term response data on vegetation and wildlife, to determine the best use of water within a given wetland unit and water year. Adaptive management would be the primary water management strategy during low water years, but may be applied under all water conditions within the range of percentages offered in the previous discussion of alternatives. Given the management objectives of Alternative E, optimal wetland management requires variability in the timing and amounts of water delivered to the wetlands, both within and among water years, to ensure continued productivity in marsh habitats. However, variability can be ensured based on individual wetland unit hydration strategies within the range of seasonal water delivery percentages offered above.

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[1]The timing of water distributed would be based on management objectives, the amount of water available for distribution, and the existing condition of wetland habitat. Potential water allocation strategies in low water years will be addressed in more detail in the Stillwater NWR Complex's Habitat Management Plan.

WATER SOURCE AND WETLAND HABITAT ACREAGE CALCULATIONS

BLR Model outputs include an estimate of wetland habitat acreage for all primary wetland areas in the Lahontan Valley. Estimates generated for Stillwater NWR include water sources to maintain approximately 800 acres of primary wetland habitat on the Fallon Paiute Shoshone Tribal wetlands. To remove this acreage from the Stillwater NWR analysis, a correction factor was generated assuming that Stillwater Marsh would account for 13,500 acres of primary wetland habitat while the Tribal wetlands would account for 800 acres (13,500 / (13,500 + 800) = 0.9441). This correction factor was also utilized to adjust estimates of the BLR model for drain and spill water to ensure that this analysis only included water flowing to Stillwater Marsh. The estimated 500 acres per year of wetland habitat at the Battleground Point area of Fallon NWR and along the lower Carson River, is not included in this analysis. The remainder of the discussion pertains only to the Stillwater Marsh portion of the total acres of wetland habitat, or 13,500 acres/year.

Adjusting output based on the above correction factor assumes that conserved Naval Air Station Fallon (NAS Fallon) water and leased water would flow into Stillwater Marsh exclusively. To factor out prime water deliveries to the Fallon Tribal wetlands, the following delivery amounts from prime water sources were used:

Stillwater Marsh Prime Water Source	Transferred Amount[2]
Carson Division (42,000 acquired)	35,880 acre-feet
Carson Division (leased) 7,130 (3 of 4 years)	5,348 acre-feet
NAS Fallon (2,700 acquired)	2,300 acre-feet
Total	43,528 acre-feet
Fallon Tribal Wetland Prime Water Source	
Carson Division (2,400 acquired)	2,050 acre-feet
Fallon Tribal Wetland/Stillwater Marsh Combined	
All Prime water sources	45,578 acre-feet

The Stillwater Marsh total was divided by the combined long-term average estimate of 45,578 acre-feet delivered to Stillwater Marsh and the Fallon Tribal wetlands (43,528/45,578) to yield a conversion factor of 0.955. This conversion factor was multiplied by the BLR model output for the total amount delivered to Stillwater Marsh and the Fallon Tribal wetlands. This was done for each alternative in order to calculate the amount of delivered water flowing to Stillwater Marsh.

[2] Sources of prime, deliverable water are assumed to be transferred at the Alpine Decree rate of 2.99 acre feet/acre.

Non-Spill Year vs. Spill Year

Because non-spill years and spill years are so different, it is important to identify the amount of water from each source which would flow into Stillwater Marsh under each scenario. According to earlier runs of the BLR Model, years of useable spills (when spill water reaches the wetlands) would occur in 24 of 95 years, or 1 of 4 years (U.S. Department of Interior 1997). Non-spill years would occur in 3 of 4 years.

In a spill year, it is assumed that: (1) the overall volume of water reaching Stillwater NWR would be higher than in a non-spill year, and (2) groundwater would not be used.

	Non-Spill Year	Spill Year
Deliverable Water	47,980 acre-feet	41,880 acre-feet
Carson Division	35,880 acre-feet	35,880 acre-feet
Carson Division (leased)	6,100 acre-feet	0 acre-feet
Middle Carson River (Segment 7)	3,700 acre-feet	3,700 acre-feet
NAS Fallon	2,300 acre-feet	2,300 acre-feet

	Non-Spill Year	Spill Year
Drainwater	10,600 acre-feet	10,600 acre-feet
Spill-water	0 acre-feet	37,350 acre-feet
Groundwater	4,810 acre-feet	0 acre-feet
Total All Sources:	63,390 acre-feet	89,830 acre-feet

Long-term average supply of water for Stillwater Marsh:

Non-spill year 63,390 acre-feet /year x 3 years = 190,170 acre-feet total in 3 years
Spill year 89,840 acre feet/year x 1 year = 89,830 acre-feet in 1 year
280,000 acre-feet in 4 years ÷ 4
= 70,000 acre-feet per year average

Inflow Volumes by Source

This model assumes that Stillwater NWR would receive 56% of water and water rights under the existing water rights acquisition program for Lahontan Valley. This figure corresponds to the proportion of wetland habitat to be maintained at Stillwater NWR (14,000 acres, or 56%), of the 25,000-acre total for primary wetland areas in the Lahontan Valley. The following discussion explains the basis of the above numbers.

Drainwater

Drainwater volumes were obtained from BLR Model outputs generated in October 2001, based on the differing seasonal pattern of deliveries that would occur under each alternative:

	BLR Model Output			Stillwater's [3] Portion
A	17,490 acre-feet	x	0.56	. 9,794 acre-feet
B	17,520 acre-feet	x	0.56	. 9,811 acre-feet
C	17,490 acre-feet	x	0.56	. 9,794 acre-feet
D	20,390 acre-feet	x	0.56	. 11,418 acre-feet
E	17,510 acre-feet	x	0.56	. 9,806 acre-feet

Monthly distribution of drainwater to Stillwater Marsh by alternative is presented in Figure 1.

Spill-water

As with drainwater, the long-term average volumes of useable spills calculated by the BLR Model varied by alternative.

Alternative	BLR Model Output	Volume of Inflow During a Spill Year
A	9,340 acre-feet per year x 4 =	37,360 acre-feet per spill year
B	10,410 acre-feet per year x 4 =	41,640 acre-feet per spill year
C	9,700 acre-feet per year x 4 =	38,800 acre-feet per spill year
D	8,290 acre-feet per year x 4 =	33,160 acre-feet per spill year
E	9,600 acre-feet per year x 4 =	38,400 acre-feet per spill year

Monthly distribution of spill water by alternative is presented in Figure 2.

Deliverable (Prime) Water

"Deliverable" water sources include those water rights that can be called for and delivered to Stillwater NWR at requested periods. It includes all water sources available under the existing water rights acquisition program, except drainwater, spill water, and groundwater.

According to the WRAP EIS and ROD, a long-term average of about 77,900 acre-feet of deliverable Carson Division water would flow into the Lahontan Valley wetlands at the completion of the acquisition program. Another 6,200 acre-feet would inflow from the middle Carson River (Segment 7). Stillwater NWR's portion of the above would be 43,700 and 3,700 acre-feet, respectively. For spill-years, leased water was subtracted because water rights would not be leased during spill years. Thus, the totals for non-spill years (3 of 4 years) and spill years (1 of 4 years) are:

[3] Stillwater NWR's portion includes drainwater flowing to the Carson Sink.

Source	Non-spill-year	Spill-year
Carson Division	44,280 acre-feet	38,180 acre-feet
Middle Carson River	3,700 acre-feet	3,700 acre-feet
	47,980 acre-feet	41,880 acre-feet

The volume of leased water, an assumed average of 6,100 acre feet per year in non-spill years, is within the range specified in the WRAP EIS. The WRAP EIS (page 2-35) stated that an "average" of 0 to 21,600 acre-feet of water rights would be leased for primary wetlands in the Lahontan Valley . It also stated that as much as 21,600 acre-feet (about 18,300 acre-feet after use-rate conversion) would be leased in 50% of the years, but that "In many years, leasing would contribute less than this amount," and that no leasing would occur in 1/3 of the years. In the remaining 1/6 of the time, it is presumed that substantially less than 18,300 acre-feet would reach the wetlands through leasing. Therefore, in 6 of 9 years, at least some water rights would reach the wetlands through leasing and in some of these years 18,300 acre feet would reach the wetlands; and in 3 of 9 years, no leasing would occur.

According to the WRAP EIS/ROD, a long-term average of about 77,900 acre-feet of deliverable Carson Division water would flow into the Lahontan Valley wetlands at the completion of the acquisition program. Another 6,600 acre-feet would inflow from the middle Carson River (Segment 7). Stillwater NWR's portion of the above would be 39,970 and 3,700 acre-feet, respectively. Figure 7 presents the total monthly deliverable water, spill water, and return flow amounts for Alternatives A through E.

Groundwater

Groundwater has been viewed as a last resort because of water-quality concerns (USFWS 1996b). Therefore, groundwater was used to make up the difference to result in annual volumes needed to achieve a long-term average of 70,000 acre feet per year for Stillwater NWR, as per the WRAP EIS (USFWS 1996a). Therefore, groundwater volume estimates varied somewhat because of differences in annual drainwater and spill water volumes among alternatives.

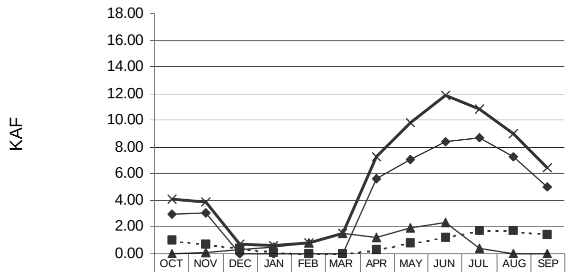
Seasonal Pattern of Drainwater Inflow

The average seasonal pattern of inflow was calculated by averaging the monthly inflows of the Diagonal Drain in 16 non-spill years during 1967-1990. Percent of totals were determined for each month and presented below.

Mon.	%	Mon.	%
Jan	3	Jul	14
Feb	2	Aug	13
Mar	3	Sep	12
Apr	6	Oct	11
May	11	Nov	7
Jun	14	Dec	3
			100

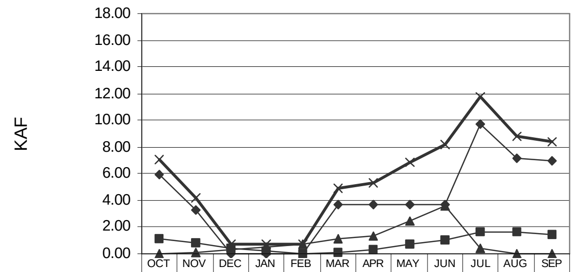
Figure 7: Monthly allocation of prime water delivery, return flow, and spill water (KAF, thousands of acre feet) for Alternatives A through E, based on September 2001, BLR model estimation.

Alternative A



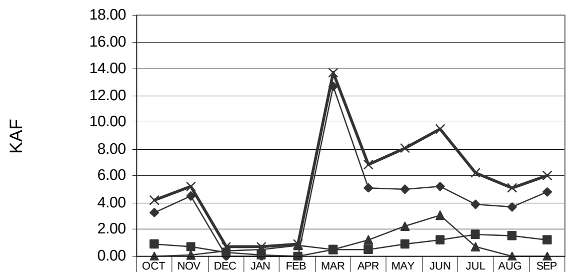
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Delivery	2.99	3.02	0.00	0.00	0.00	0.00	5.65	7.02	8.34	8.74	7.22	4.97
Return Flow	1.07	0.77	0.38	0.11	0.02	0.01	0.33	0.82	1.19	1.69	1.77	1.46
Spill Water	0.00	0.09	0.33	0.54	0.79	1.50	1.28	1.98	2.38	0.44	0.00	0.00
Total	4.06	3.88	0.71	0.65	0.81	1.51	7.26	9.82	11.91	10.87	8.99	6.42

Alternative B



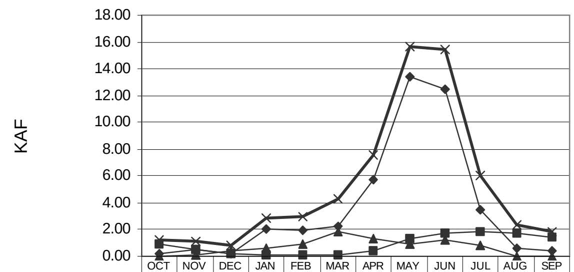
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Delivery	5.96	3.30	0.00	0.00	0.00	3.66	3.66	3.66	3.66	9.67	7.16	6.98
Return Flow	1.11	0.84	0.43	0.16	0.04	0.15	0.31	0.73	1.00	1.66	1.66	1.45
Spill Water	0.00	0.09	0.30	0.51	0.69	1.09	1.35	2.43	3.56	0.39	0.00	0.00
Total	7.07	4.24	0.73	0.67	0.73	4.90	5.32	6.82	8.22	11.73	8.82	8.43

Alternative C



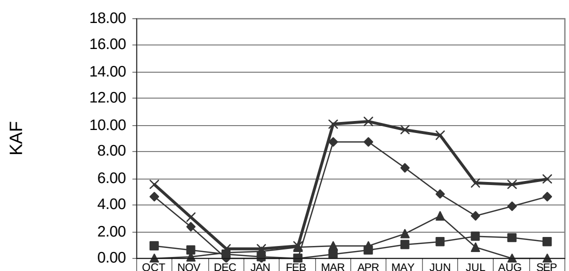
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Delivery	3.32	4.48	0.00	0.00	0.00	12.67	5.12	4.98	5.21	3.86	3.67	4.76
Return Flow	0.92	0.67	0.33	0.12	0.03	0.51	0.49	0.93	1.23	1.63	1.49	1.27
Spill Water	0.00	0.09	0.36	0.55	0.86	0.56	1.26	2.20	3.07	0.76	0.00	0.00
Total	4.24	5.24	0.69	0.67	0.89	13.74	6.87	8.11	9.52	6.24	5.16	6.02

Alternative D



	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Delivery	0.24	0.48	0.19	2.09	1.95	2.29	5.76	13.45	12.49	3.47	0.57	0.37
Return Flow	0.96	0.54	0.25	0.15	0.11	0.15	0.43	1.31	1.72	1.81	1.72	1.47
Spill Water	0.00	0.15	0.42	0.61	0.89	1.89	1.37	0.89	1.25	0.79	0.02	0.00
Total	1.20	1.17	0.85	2.86	2.95	4.34	7.56	15.64	15.46	6.07	2.31	1.84

Alternative E



	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Delivery	4.60	2.38	0.00	0.00	0.00	8.78	8.78	6.83	4.87	3.23	3.95	4.66
Return Flow	0.92	0.64	0.33	0.11	0.02	0.35	0.57	0.98	1.24	1.62	1.57	1.28
Spill Water	0.00	0.10	0.37	0.56	0.86	0.92	0.92	1.90	3.15	0.82	0.00	0.00
Total	5.52	3.13	0.70	0.67	0.88	10.04	10.26	9.71	9.26	5.67	5.52	5.94

Modeled Wetland Acreage

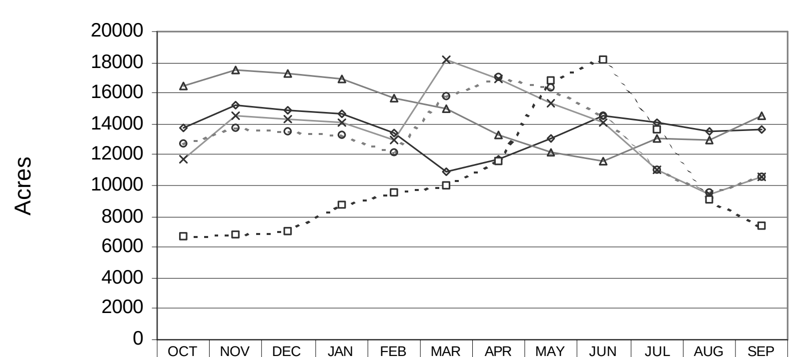
Based on modeled water availability from the combined, water sources (prime water delivery including leased and middle Carson River acquisition and transfer, spill water, and drain water flow), alternatives would have an average of 62,250 acre feet per year (Alternative D) to 67,660 acre-feet per year (Alternative B) available to maintain wetland habitat in Stillwater Marsh (Table Resulting annual wetland habitat acreage ranges from 10,464 acres (Alternative D) to 14,705 acres (Alternative B) using the aforementioned sources. The annual average acreage totals

Table 1: Stillwater NWR water receipts for exisiting conditions[1] and completion[2] of the water rights acquisition program (1996 WRAP).				
	Stillwater NWR Water Receipts by source			
	Total KAF	Return Flow KAF	Spill Water KAF	Delivery KAF
Alt A 20K	43.19	18.9	8.28	16.01
Alt A 42K	62.47	9.62	9.34	43.52
Alt B 42K	63.26	9.53	10.41	43.31
Alt C 42K	62.96	9.62	9.70	43.63
Alt D 42K	58.25	10.61	8.29	39.35
Alt E 42K	62.87	9.63	9.60	43.64
[1] - existing conditons = Alternative A with 20,000 acre feet acquired				
[2] - completion of the WRAP = 42,000 acre feet acquired				

presented in Table 1 are representative of average annual wetland habitat acreage generated from 95 simulation years which includes all projected spill, normal, and low water years.

Stillwater Marsh monthly wetland habitat acreages estimated by the BLR model vary widely by alternative, with Alternative D producing the highest (18,202 acres in June) and lowest (6,667 acres in October) wetland acreage among the alternatives (Figure 8). Alternatives A and B would achieve peak wetland acreage in November, while Alternative C and E would experience peak acreage in March and April, respectively. Although Alternative E would reach a peak of 17,047 acres in April, which is a key period for waterfowl nest initiation, it is anticipated that the spring pulse will be concluded by April 1 in one identified flow corridor while the remaining April deliveries will be used to stage a slow filling of wetlands spread among two other corridors. Wetland units within these two corridors would not be filled further if nesting habitat was already optimal and large numbers of breeding pairs were already using the unit. Lahontan Valley wetland acreage peak months are similar to Stillwater NWR peak acreage months except that the Lahontan Valley peak month would change to April instead of March for Alternative C.

Figure 8: Stillwater NWR monthly, primary wetland habitat acres estimated by September 2001, BLR model runs.



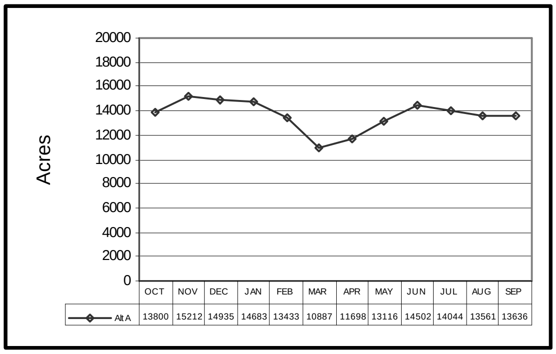
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Alt A	13800	15212	14935	14683	13433	10887	11698	13116	14502	14044	13561	13636
Alt B	16427	17525	17233	16982	15627	14972	13344	12129	11590	13068	12964	14597
Alt C	11666	14590	14326	14083	12905	18190	16965	15367	14067	11070	9453	10516
Alt D	6667	6801	7038	8780	9574	9963	11536	16871	18202	13629	9144	7363
Alt E	12717	13774	13541	13321	12211	15740	17047	16407	14536	11000	9585	10527

Low acreage months also vary by alternative at Stillwater Marsh with the baseline Alternative A low of 10,887 acres occurring in March and the Alternative B low (11,590 acres) in June. Alternative's C and E both reach minimum acreage in August (9,453 and 9,585 acres, respectively). The Lahontan Valley wetland minimum acreage occurs in the same months as the Stillwater NWR minimum with the exception that the Alternative B minimum for the Lahontan Valley wetlands occurs in May instead of June.

Stillwater NWR Wetland Acreage by Alternative

Alternative A

Figure 9: Monthly wetland acreage created using the Alternative A water delivery strategy.

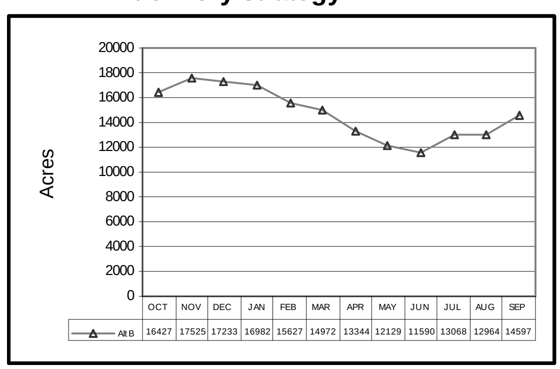


The Alternative A water delivery strategy mirrors the agricultural delivery pattern and ultimately produces a peak Stillwater NWR wetland acreage in November (15,212 acres) followed by a minimum acreage in March (10,887 acres; Figure 9). This would provide a large amount of habitat for fall migratory and wintering waterfowl and again for breeding waterbirds; however, this strategy could result in significant flooding of waterfowl nests as wetland water levels would continue to rise from March through June. Alternative A is the No Action Alternative; and, because it is the baseline for comparisons, it assumes full implementation of the 1988 Newlands Project Operating Criteria and Procedures (OCAP), as adjusted (U. S. Bureau of Reclamation 1997), and completion of the Service's water rights acquisition program as specified in the WRAP ROD. Effects of implementing the 1997 adjustments to the 1988 Newlands Project OCAP were evaluated in an environmental assessment (USDOI 1997). These effects are part of the existing baseline (Alternative A).

Alternative B

The Alternative B delivery strategy, using a fall flooding emphasis, was designed to maximize wetland acreage for fall migratory and wintering waterfowl with carryover into the following spring (Figure 10). Peak Stillwater NWR wetland acreage (17,525 acres) would occur in November at the conclusion of the irrigation season (March 15 - November 15), with a minimum wetland acreage projected for June (11,590 acres). The annual pattern would generally follow a slow increase in wetland acreage from June through November followed by a slow decline from December through May. This alternative's strategy would assure that waterbird nest flooding was minimized but would begin filling wetland habitat and decreasing invertebrate density when late summer migratory shorebirds would be passing through on their southern migration. Overall, this alternative would provide maximum benefits for migrating and wintering waterfowl,

Figure 10: Monthly wetland acreage created using the Alternative B water delivery strategy.

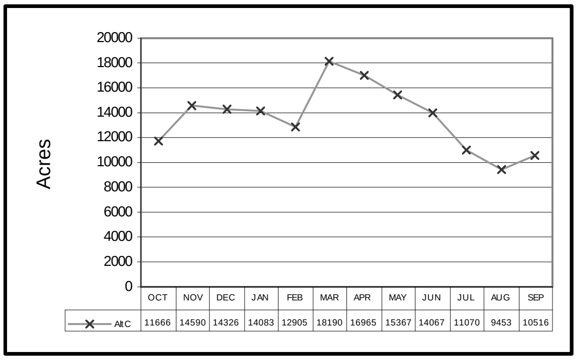


would minimize nest flooding for waterfowl, but would minimize habitat suitability for late summer/fall migratory shorebirds.

Alternative C

The Alternative C strategy was developed to approximate natural wetland conditions by simulating natural ecological processes, with adjustments made to the strategy in recognition that elevated fall deliveries to Stillwater Marsh would help to mitigate the reduced wetland-habitat acreage across the Great Basin. Thus, Alternative C would experience peak wetland acreage in March (18,190 acres), low acreage in August (9,453 acres), and a supplemental peak in November (14,590 acres) to provide habitat for fall migratory and wintering waterfowl (Figure 11). Peak acreage in March would result from initiation of spring pulse flows whereby approximately 26% of available water would be delivered throughout the marsh from March 15 through April 1. Although Alternative D best mimics the natural seasonal pattern of inflow, Alternative C appears to allow for a more natural seasonal pattern of wetland habitat acres. Projected benefits through implementation of this strategy would include:

Figure 11: Monthly wetland acreage created using the Alternative C water delivery strategy.



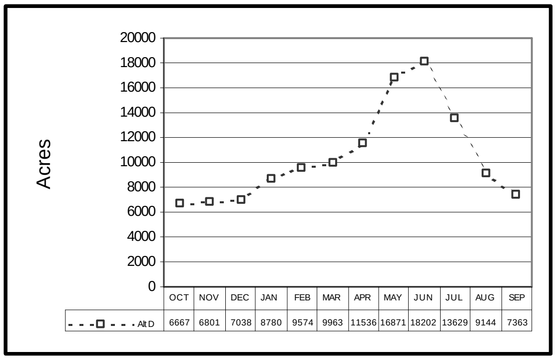
1) providing large acreages of breeding habitat and sustaining late spring/early summer habitat for waterbird production,
2) reducing salt content in wetlands higher on the hydrologic gradient (e.g., sanctuary wetland units) to provide conditions suitable for re-establishment of native vegetation,
3) increasing wetland acreage and stimulating spring invertebrates prior to peak spring shorebird migration (units would be drawing down at peak of migration in mid May),
4) further concentrating invertebrates during late summer for fall migratory shorebirds and early waterfowl, and
5) flooding up fall and winter habitat for fall migratory and wintering waterfowl with anticipated carryover for spring migration.

Shortfalls of this approach would include the potential to flood a small number of March-initiated waterfowl nests and an indeterminate ability to reduce salt content throughout refuge wetlands with a significantly reduced water allotment.

Alternative D

Alternative D was developed to mirror the historic hydrology by delivering water to Stillwater Marsh, proportional[4] to monthly estimates of water flow prior to Newlands Project development (Figure 12). Implementation of this alternative would provide the widest range of wetland acreage extremes with a peak wetland acreage occurring in June (18,202 acres) and a minimum occurring in October (6,667 acres). While this alternative would come closest to restoring and maintaining the natural seasonal pattern of wetland inflow, it would not restore the natural biological diversity on the refuge to the same degree as Alternatives C and E. It would also result in several shortfalls in providing for the conservation and management of migratory bird resources. First, filling wetland units in April, May, and June would result in significant flooding of initiated waterbird nests. Second, delivery of most acquired water during this period of high evapotranspiration would leave little water available to fill fall and wintering habitat for migratory waterfowl. Finally, with a diminished fall wetland acreage, less habitat would carry over to the following spring. Implementation of Alternative D would come closest to restoring and maintaining natural biological diversity at Stillwater NWR but would result in detrimental impacts to migratory, wintering, and breeding waterbirds.

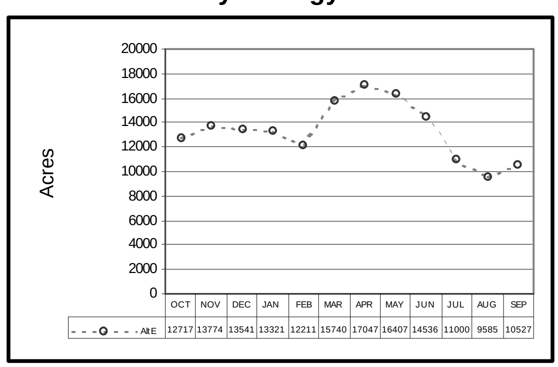
Figure 12: Monthly wetland acreage created using the Alternative D water delivery strategy.



Alternative E

The Service preferred Alternative E was structured to account for the benefits and shortfalls provided in Alternatives B through D based on comments received on the Draft CCP EIS (Figure 13). Peak wetland acreage would occur in April (17,047 acres) with minimum acreage occurring in August (9,585 acres), and a secondary peak occurring in November (13,774 acres), similar to Alternative C. Spring pulse water distribution would be lowered under this alternative. However, this water would be focused within 1 of 4 identified flow corridors within the refuge, which should allow for flushing flows to achieve higher velocity than

Figure 13: Monthly wetland acreage created using the Alternative E water delivery strategy.



[4] Average flow to Stillwater Marsh was in excess of 290,000 acre feet historically. Completion of the water rights acquisition program would yield approximately 63,000 acre feet in a full water year.

under Alternative C and may allow for limited scouring and improved transport of salts. Increases in wetland habitat during April would be distributed among three flow corridors and would be anticipated to produce only slight individual wetland unit depth increases. Therefore, nest flooding would remain limited to only the earliest initiated nests, and migratory shorebird and waterfowl brood habitat would be spread across a wider area of the refuge than under Alternative C. Although fall habitat acreage would appear to be lower than was provided under Alternative C, fall delivery percentages would actually increase under Alternative E to allow for up to 25% of acquired water to be delivered in October and November in an average non-spill year (raised from 10% under Alternative C). Overall benefits would be similar to those examined under Alternative C with an increased focus on where spring pulse water is delivered and increased flexibility in providing fall habitat through October and November deliveries.

EFFECTS OF ALTERNATIVE WATER MANAGEMENT STRATEGIES

Potential Effects to the Carson Division of the Newlands Project

Several comments received on the Draft CCP EIS questioned how alternative specific delivery strategies would affect operation of the Newlands Project. This section, addresses these concerns, but will be limited to discussion of the Carson Division of the Newlands Project and Lahontan Reservoir operation only.

Operation of Lahontan Reservoir is regulated by the 1988 Newlands Project Operating Criteria and Procedures (OCAP) as amended in 1997 (U.S. Department of the Interior 1997). As it relates to the Carson Division of the Newlands Project, Lahontan Reservoir release is a function of the amount of water individual irrigators are entitled to receive (headgate entitlement) divided by the OCAP designated efficiency for the delivery, which together form the Carson Division Demand. Carson Division Demand is used to establish Lahontan Reservoir storage targets, which were developed to ensure that individual irrigators within the Newlands Project would be provided with adequate storage in Lahontan Reservoir to meet their headgate entitlement in nine of ten years over the long-term. When there is inadequate water stored in Lahontan Reservoir to meet the Carson Division Demand, water can be released from Lahontan Reservoir until the storage capacity is reduced to 4,000 acre-feet, at which time the irrigation season for that year officially ends unless the water supply is replenished. When the amount of water stored in Lahontan Reservoir is forecasted to exceed the maximum storage capacity of 295,000 acre-feet, then water is released from Lahontan Reservoir as spill water which does not count against headgate entitlement.

The following discussion summarizes the potential effects of CCP EIS alternatives on Lahontan Reservoir operation (Table 2).

For comparison purposes, Alternative A was evaluated both at existing conditions (approximately 20,000 acre-feet of water acquired for Stillwater NWR) and at the completion of the Service's Water Rights Acquisition Program (WRAP), as described in the 1996 WRAP EIS and ROD (approximately 42,000 acre-feet/year of water acquired for Stillwater NWR). Alternatives B through E were evaluated for completion of the WRAP only. Based on BLR model runs, Carson Division Demand would be approximately 272,770 acre-feet per year at existing

Table 2: Alternative specific Carson Division Demand, Lahontan Reservoir release source, Carson Division Efficiency, and Stillwater delivery for existing conditions and completion of the water rights acquisition program (1996 WRAP ROD).

	Carson Division of the Newlands Project/Lahontan Reservoir Statistics				
	CD[1] Demand KAF	Lahontan Release KAF	Lahontan Spill KAF	Headgate Delivery KAF	Project Efficiency %
Alt A 20K	272.77	265.32	41.37	169.20	63.80
Alt A 42K	239.70	235.82	56.79	167.53	71.00
Alt B 42K	239.59	235.64	57.77	167.34	71.00
Alt C 42K	239.64	236.03	56.23	167.75	71.10
Alt D 42K	231.17	228.56	58.02	161.78	70.80
Alt E 42K	239.62	236.02	56.10	167.76	71.10

	Stillwater Delivery Statistics	
	Stillwater Delivery KAF	% of Delivery[2] %
Alt A 20K	16.01	0.09
Alt A 42K	47.94	0.29
Alt B 42K	47.71	0.29
Alt C 42K	48.07	0.29
Alt D 42K	43.35	0.27
Alt E 42K	48.07	0.29

[1] - CD = Carson Division of the Newlands Project, does not account for Truckee Division water use.
[2] - Stillwater NWR Delivery percent of Carson Division Headgate Delivery.

conditions and would range from 231,170 acre-feet per year (Alternative D) to 239,700 acre-feet per year (Alternative A) at completion of the WRAP. Based on filling headgate entitlement in nine out of ten years, Lahontan Reservoir Release to meet Carson Division Demand would range from 228,560 acre-feet per year (Alternative D) to 236,030 acre-feet per year (Alternative C). Model runs show that Lahontan Reservoir spills would occur in about one of four years, with spill amounts ranging from 55,740 acre-feet per year (Alternative E) to 57,300 acre-feet per year (Alternative B). Delivery efficiency would increase from 63.8% under Alternative A (for existing conditions) to an estimated 71% under all alternatives at completion of the WRAP. Based on delivery of water to Stillwater NWR through all acquired sources, an estimated 16,010 acre-feet per year would reach the wetlands at present which would account for approximately 9% of the total Carson Division headgate delivery. At completion of the WRAP, these amounts would range from 43,350 acre-feet per year (Alternative D) to 48,070 acre-feet per year (Alternatives C and E), which represents 27% to 29% of the total Carson Division headgate delivery.

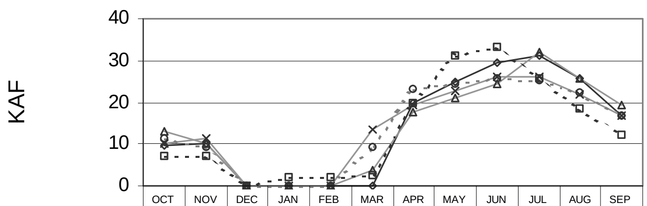
Seasonal headgate delivery patterns would vary by alternative with the Alternative A strategy representing the agricultural delivery pattern. No March deliveries occurred in 1996 even though the second half of March is within the irrigation season; all action Alternatives (B through E) are assumed to receive March deliveries. Because Stillwater NWR deliveries account for 27-29% of the total Carson Division delivery amount, alternative specific delivery patterns would have some influence on total receipts in the Carson Division (Figure 14). For example, implementation of the Alternative B delivery strategy (fall delivery emphasis) would reduce the Carson Division demand during the spring and summer months but would increase demand during the fall months. Conversely, the headgate delivery patterns of Alternatives C and E would increase demand during early spring months (March and April), reduce demand during late spring and summer (May through September), and result in similar demand patterns to

Alternative A during fall (October and November). Alternative D would result in a demand reduction in all months except May and June, in which peak Stillwater NWR demand would be adjusted to represent historic May and June runoff in the historic Carson River system.

Delivery of water to Stillwater NWR is anticipated to be more efficient than deliveries to the Carson Division as a whole, primarily because larger blocks of water would be delivered through two primary canals (S-line and L-line), as opposed to the multi-canal and lateral system required to irrigate agricultural lands in the Carson Division. Alternatives which would require more water early in the spring (Alternatives C and E) would slightly increase efficiency during spring months while Alternative B would increase efficiency during fall months as compared to baseline Alternative A (Figure 15). As more water is acquired from agricultural lands and transferred to the wetlands, there would be seasonal efficiency increases. Implementation of all action alternatives would achieve roughly the same overall efficiency (71%) across the delivery period, as a consequence of the WRAP, and is beyond the scope of this EIS. It should be noted that these efficiency increases were generated by the BLR Model and there is no way to verify whether this will be the case until the WRAP is completed. Carson Division deliveries, primarily to Stillwater NWR, during fall 2001 were estimated to have resulted in a 91.5% efficiency rating (Lahontan

Figure 14: Alternative specific, monthly headgate delivery patterns estimated by the BLR model, September 2001.

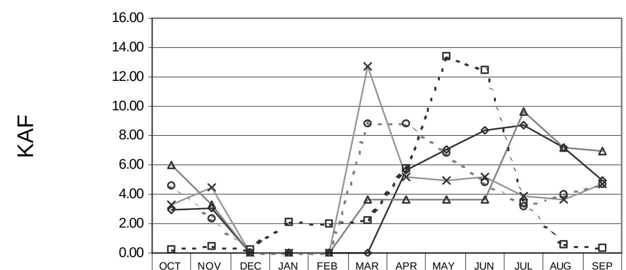
Carson Division Headgate Delivery



	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Alt A	9.78	9.91	0	0	0	0	19.87	24.78	29.48	31.12	25.54	17.05
Alt B	12.89	10.2	0	0	0	3.83	17.78	21.26	24.58	32.07	25.58	19.17
Alt C	10.18	11.42	0	0	0	13.27	19.31	22.64	26.19	26	21.86	16.87
Alt D	6.99	7.34	0.2	2.19	2.04	2.4	19.95	30.95	33.29	25.53	18.62	12.28
Alt E	11.5	9.26	0	0	0	9.19	23.14	24.58	25.83	25.34	22.17	16.76

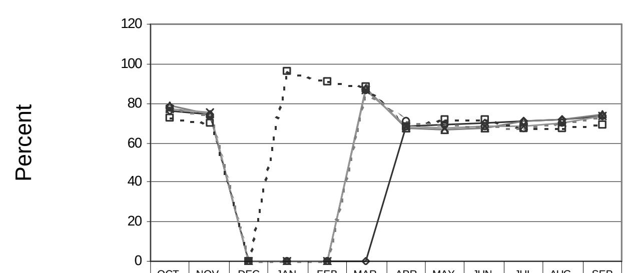
Figure 15: Alternative specific, monthly Stillwater NWR prime water delivery and Carson Division of the Newlands Project delivery efficiency.

Stillwater Prime Water Delivery



	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Alt A	2.99	3.02	0.00	0.00	0.00	0.00	5.65	7.02	8.34	8.74	7.22	4.97
Alt B	5.96	3.30	0.00	0.00	0.00	3.66	3.66	3.66	3.66	9.67	7.16	6.98
Alt C	3.32	4.48	0.00	0.00	0.00	12.67	5.12	4.98	5.21	3.86	3.67	4.76
Alt D	0.24	0.48	0.19	2.09	1.95	2.29	5.76	13.45	12.49	3.47	0.57	0.37
Alt E	4.60	2.38	0.00	0.00	0.00	8.78	8.78	6.83	4.87	3.23	3.95	4.66

Carson Division Delivery Efficiency



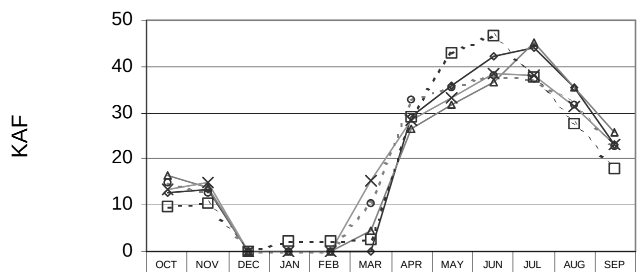
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Alt A	76.5	74.1	0	0	0	0	68.7	69.1	69.9	70.6	72.1	73.4
Alt B	78.7	74.5	0	0	0	87.8	67.1	66.8	67.3	71	72	74.6
Alt C	76.7	75.6	0	0	0	86.9	68.4	67.8	68.3	68.1	70.1	73.2
Alt D	72.7	70.2	0	96.4	91	88.6	68.7	72.2	71.6	67.8	67.7	69.2
Alt E	77.8	73.3	0	0	0	87	70.8	69	68.1	67.8	70.3	73.2

Valley News and Fallon Eagle Standard, Friday November 9, 2001) which would suggest that this may be the case in the future.

Based on the model generated efficiency percentages, Lahontan Reservoir releases to meet headgate entitlement would generally follow the headgate demand statistics offered in the previous discussion (Figure 16). Lahontan Reservoir spill amounts would be similar among alternatives with the primary spill period generally occurring in May and June for all alternatives. Alternatives A, B, C, and E would follow roughly the same pattern in spill years while Alternative D would result in slightly higher spill amounts during March (5,910 acre-feet), and slightly lower amounts during May and June (16,680 and 21,520 acre-feet, respectively). This is based on alternative specific delivery patterns which operate under model assumptions, regardless of whether the water year is a low, normal, or spill year. In reality, the refuge would generally not seek to follow the alternative specific delivery patterns during spill years but, instead, would wait until the spill period ended to call for acquired water rights. Approximately 56% of the spill volume is assumed to enter either Stillwater Marsh or the Carson River delta under all alternatives.

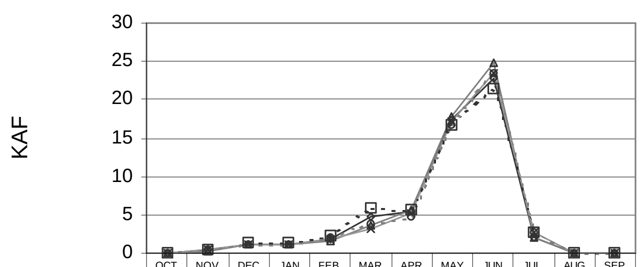
Figure 16: Alternative specific, monthly Lahontan Reservoir release and Lahontan Reservoir spill, estimated by the BLR model, September 2001.

Lahontan Reservoir Release



	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Alt A	12.78	13.37	0	0	0	0	28.92	35.87	42.15	44.08	35.41	23.23
Alt B	16.37	13.7	0	0	0	4.36	26.5	31.81	36.51	45.19	35.51	25.69
Alt C	13.26	15.11	0	0	0	15.28	28.25	33.39	38.33	38.16	31.21	23.04
Alt D	9.62	10.46	0	2.27	2.24	2.71	29.02	42.89	46.46	37.64	27.49	17.76
Alt E	14.78	12.64	0	0	0	10.56	32.67	35.62	37.91	37.39	31.55	22.91

Lahontan Reservoir Spill



	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Alt A	0	0.35	1.12	1.19	1.76	4.63	5.43	17.35	22.88	2.09	0	0
Alt B	0	0.29	1.03	1.13	1.62	3.57	5.54	17.89	24.7	2.01	0	0
Alt C	0	0.37	1.2	1.21	1.91	3.17	5.27	17.14	23.36	2.61	0	0
Alt D	0	0.5	1.45	1.44	2.25	5.91	5.57	16.68	21.52	2.67	0.04	0
Alt E	0	0.37	1.21	1.23	1.94	3.86	4.8	16.63	23.35	2.71	0	0

As discussed earlier, CCP EIS action alternatives are modeled to account for approximately 27-29% of Carson Division demand at completion of the WRAP. Monthly demand statistics vary by alternative and month with action Alternatives B through E accounting for 100% of demand in December[5] through March, and varying amounts from March through November depending on whether the action Alternative represents a spring (Alternatives C and E), summer (Alternative D), or fall (Alternative B) delivery pattern. Alternative D would result in the highest (43.4%,

[5] Alternative D is the only action Alternative which would seek to receive delivered water outside of the March 15 through November 15 delivery season. Alternative A was patterned after actual 1996 delivery receipts and no March deliveries occurred in this year.

Table 3: Average Lahontan Reservoir Demand, number of Lahontan Reservoir Shortage Years, Average Lahontan Reservoir Release in Shortage Years, and monthly percent of water available to meet demand for Alternatives A through E, based on BLR model runs generated, September 2001.

			OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL
Alt A	Avg LR1 Demand	KAF	13.6	13.8	0.0	0.0	0.0	0.0	28.9	35.9	42.2	44.5	36.4	24.4	239.7
13	Avg LR Release in Shortage Years	KAF	7.3	10.7	0.0	0.0	0.0	0.0	28.9	35.9	42.1	41.3	29.2	15.5	210.9
Shortage	Avg LR Release - LR Demand	KAF	6.4	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	7.1	8.9	28.8
Years	% of LR Demand not available2	%	**0.47**	**0.22**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	**0.20**	**0.37**	0.12
Alt B	Avg LR Demand	KAF	17.5	14.1	0.0	0.0	0.0	4.4	26.5	31.8	36.5	45.6	36.3	27.0	239.6
12	Avg LR Release in Shortage Years	KAF	8.8	10.6	0.0	0.0	0.0	4.5	26.4	31.7	36.3	42.7	30.2	16.8	207.8
Shortage	Avg LR Release - LR Demand	KAF	8.7	3.5	0.0	0.0	0.0	0.0	0.1	0.1	0.2	2.9	6.1	10.2	31.8
Years	% of LR Demand not available	%	**0.50**	**0.25**	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.06	0.17	**0.38**	0.13
Alt C	Avg LR Demand	KAF	14.1	15.6	0.0	0.0	0.0	15.3	28.3	33.4	38.4	38.6	32.0	24.1	239.6
13	Avg LR Release in Shortage Years	KAF	8.2	12.0	0.0	0.0	0.0	15.8	28.2	33.3	37.9	35.3	26.1	16.0	212.8
Shortage	Avg LR Release - LR Demand	KAF	5.8	3.7	0.0	0.0	0.0	0.0	0.0	0.1	0.5	3.3	5.9	8.1	26.8
Years	% of LR Demand not available	%	**0.42**	**0.23**	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.08	0.18	**0.34**	0.11
Alt D	Avg LR Demand	KAF	10.1	10.6	0.0	2.3	2.2	2.7	29.0	42.9	46.6	38.1	28.1	18.6	231.2
11	Avg LR Release in Shortage Years	KAF	5.8	9.3	0.0	2.4	2.3	2.8	29.0	42.6	45.2	34.0	22.3	11.2	207.0
Shortage	Avg LR Release - LR Demand	KAF	4.3	1.3	0.0	0.0	0.0	0.0	0.0	0.3	1.4	4.1	5.8	7.3	24.2
Years	% of LR Demand not available	%	**0.42**	0.12	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.11	**0.21**	**0.40**	0.10
Alt E	Avg LR Demand	KAF	15.7	13.0	0.0	0.0	0.0	10.6	32.7	35.6	38.0	37.8	32.3	24.0	239.6
13	Avg LR Release in Shortage Years	KAF	8.9	10.6	0.0	0.0	0.0	10.9	32.8	35.6	37.4	34.5	26.4	15.8	212.9
Shortage	Avg LR Release - LR Demand	KAF	6.8	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.6	3.3	5.9	8.3	26.8
Years	% of LR Demand not available	%	**0.43**	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.09	0.18	**0.34**	0.11

1 - LR = Lahontan Reservoir

1 - bold indicates months in which greater than 20% of demand is not available to meet headgate entitlement in shortage years.

May) and lowest (3%, September) percent of Carson Division demand with all other alternatives ranging from 46.2 % (Alternative B, October) to 12.7% (Alternative E, July) from April through November. Alternative A would range from 28.1% (July) to 30.6% (October).

The number of Carson Division shortage years and amounts would also vary by alternative with model results showing 13 shortage years for Alternatives A, C, and E, and 12 shortage years for Alternative B, and 11 shortage years for Alternative D (Table 3). Shortage amounts averaged over the number of shortage years for each alternative range from 24,200 acre-feet per year (Alternative D) to 31,800 acre-feet per year (Alternative B) with the highest monthly shortfalls occurring from August through November. All alternatives achieved the highest shortfall amounts in October, in which shortfall amounts ranged from 42% (Alternative's C and D) to 50% (Alternative B) of the amount required to meet Carson Division headgate entitlement.

Relationship to the 1997 OCAP[6]

Other commentors on the Draft CCP EIS inquired as to how changes to the agricultural delivery pattern resulting from action Alternatives B through E might affect the ability to meet monthly Lahontan Reservoir Storage objectives. The 1997 Adjusted OCAP presents a complex equation used to determine the monthly Lahontan Reservoir storage objective which is subsequently used to determine the amount of Truckee River water which must be diverted to meet this objective. When the Carson River maintains sufficient flow to fulfill tabled storage objectives for a set Carson Division demand, Truckee River diversion does not occur. When flow is inadequate, Lahontan Reservoir storage objectives are determined by the following equation:

LSOCM = TSM/J - (C1*AJ) + L + (**<u>C2</u>***CDT)

LSOCM = current end of month Lahontan storage objective
TSM/J = current end of month storage target (static from OCAP table based on annual diversion)
C1*AJ = forecasted Carson river inflow (C1 - static coefficient)
L = average Lahontan storage/seepage loss (static)
C2 = coefficient based on long-term average monthly demand (static)
CDT = total projected Carson Division demand

Truckee River Diversion is calculated by the following equation:

TRD = TDD + TCL + CDD + LRL + LSOCM - ALRS - CRI

TRD = current month Truckee River Diversion
TDD = current month Truckee Division Demand (Fernley, Swingle Bench, etc...)
TCL = current month Truckee Canal conveyance loss
CDD = current month Carson Division Demand (CDT above)

[6] The 1988 Newlands Project Operating Criteria and Procedures as amended (1997); 43CFR Part 418.

LRL = current month Lahontan storage/seepage loss (static)
LSOCM = current month Lahontan storage objective
ALRS = current month/beginning of month Lahontan storage (changed to reflect accumulated Stampede credit, efficiency penalty of credit)
CRI = current month anticipated Carson River inflow

The primary concern of several commentors is related to the C2 coefficient which represents the estimated demand, and it assumes a standard agricultural delivery pattern. Both May and June C2 coefficients are used in the above equation with the lowest calculated value by using the May C2 coefficient, June C2 coefficient, or the tabled Lahontan Reservoir Storage Objective is used in the Truckee River diversion calculation (TRD). The May C2 coefficient represents a decreasing fraction of the total Carson Division demand from January through May, with the fraction reduced by the previous month's use of demand across the January through May period of reference. The June C2 coefficient is calculated similarly except that the period of reference is from January through June. Table 4 presents the 1997 OCAP May and June C2 coefficients.

Table 4: May and June C2 coefficients provided in the 1988 Newlands Project Operating Criteria and Procedures as amended (1997).

	JAN	FEB	MAR	APR	MAY
May C2	0.30	0.30	0.28	0.18	
June C2	0.47	0.47	0.45	0.35	0.17

All alternatives evaluated in this analysis, including Alternative A, would deviate from the long-term demand statistics used to calibrate the 1997 Adjusted OCAP C2 coefficients (Table 5). Because Alternative A was patterned after actual delivery statistics collected in the 1996 water year, where no March deliveries occurred, the January, May C2 coefficient dropped from the 0.30 1997 Adjusted OCAP value to 0.27. This means only 27% of Carson Division demand would be met from January through May under this alternative. Each action alternative varies slightly from the 1997 Adjusted OCAP coefficients based on whether the action alternative emphasis was focused on spring deliveries (Alternatives C and E, January C2 coefficients of 0.32 and 0.33 respectively), summer delivery (Alternative D, January C2 coefficient of 0.33), or fall (Alternative B, January C2 coefficient of 0.26).

Table 5: May and June C2 coefficients provided in the 1988 Newlands Project Operating Criteria and Procedures as amended (1997) as modified by Stillwater NWR CCP-EIS Alternatives A through E.

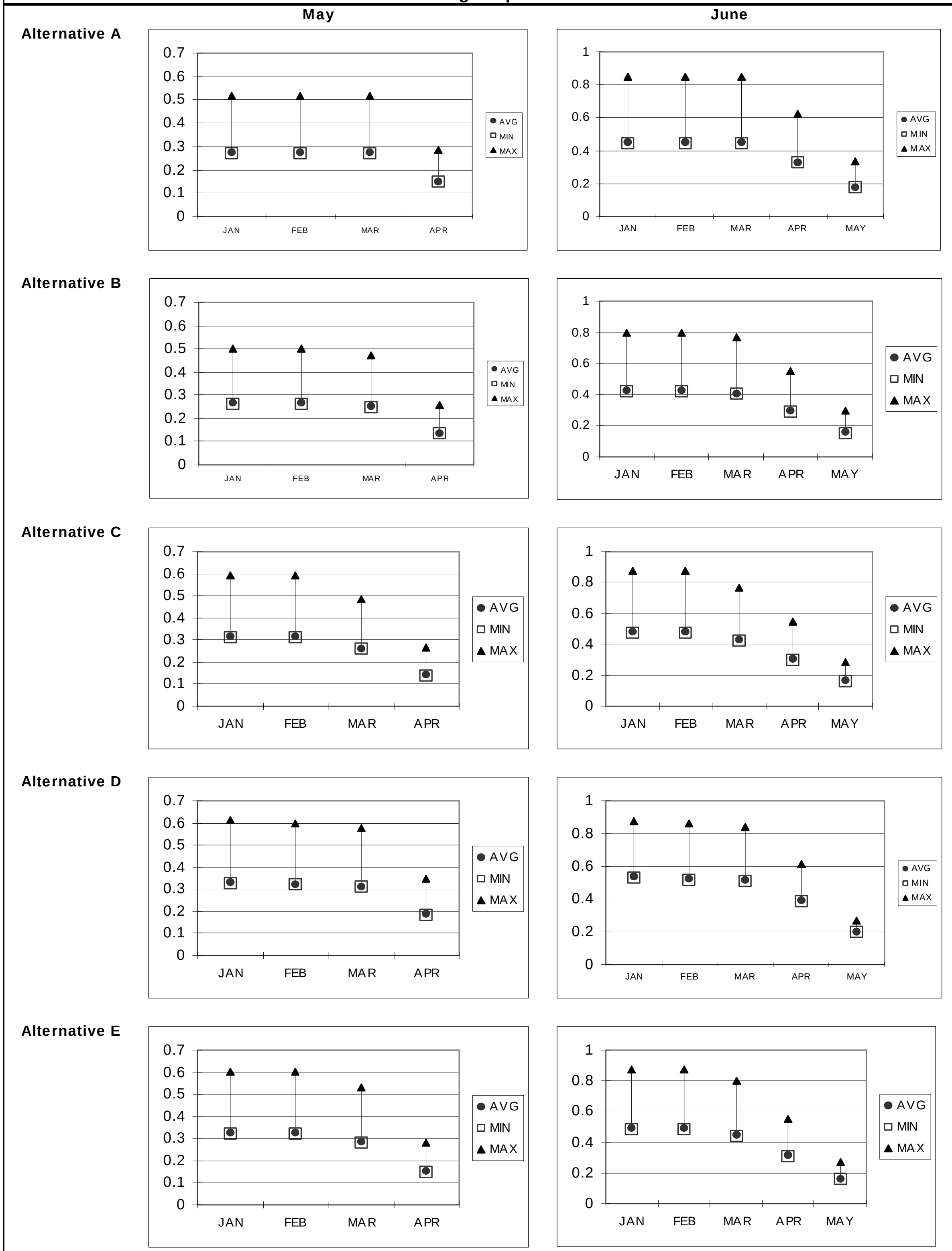
	May C2 Coefficient				
	JAN	**FEB**	**MAR**	**APR**	
OCAP	0.30	0.30	0.28	0.18	
Alt A	0.27	0.27	0.27	0.15	
Alt B	0.26	0.26	0.24	0.13	
Alt C	0.32	0.32	0.26	0.14	
Alt D	0.33	0.32	0.31	0.19	
Alt E	0.33	0.33	0.28	0.15	
	June C2 Coefficient				
	JAN	**FEB**	**MAR**	**APR**	**MAY**
OCAP	0.47	0.47	0.45	0.35	0.17
Alt A	0.45	0.45	0.45	0.33	0.18
Alt B	0.41	0.41	0.40	0.29	0.15
Alt C	0.48	0.48	0.42	0.30	0.16
Alt D	0.53	0.52	0.51	0.39	0.20
Alt E	0.49	0.49	0.44	0.31	0.16

Considering the change associated with examining an individual water year (Alternative A based on 1996 delivery patterns), it becomes necessary to examine the range of Carson Division demand variability associated with low, normal, and spill years generated by the 95-year BLR Model runs (Figure 18). During modeled shortage years (11 to 13 depending on the alternative examined), a much higher proportion of Carson Division demand is satisfied early in the year because the irrigation season promptly ends when Lahontan Reservoir storage is depleted. The maximum values depicted in Figure 18 are representative of the emphasis on early season deliveries experienced in these shortage years. In normal water years, the demand patterns remain relatively constant among CCP EIS alternatives and are represented by the average values provided in Table 5. While the BLR Model is unable to account for spill years and cool springs in which irrigation deliveries are delayed until the spill period ends or the growing season begins, these years would account for far less demand satisfied during the January through May or January through June periods. Thus, the C2 coefficients resulting from implementation of the CCP EIS action alternatives would fall within a range of Carson Division demand values provided when all shortage, normal, or spill years are examined.

SUMMARY AND DISCLAIMER

Again, it should be emphasized that all statistics provided in this analysis were generated by September 2001 runs of the BLR Model and that the presented conditions may or may not occur in the future. The BLR Model uses 95 years of historic hydrologic data, modified to reflect current Newlands Project operations criteria. However, it cannot be assumed that the model generated results are representative of conditions that will occur in the future. The BLR Model provides a proven tool for comparing gross differences among water management alternatives, as the original developers of the model envisioned, and is the best available tool for analyzing alternatives such as were evaluated in this Final CCP EIS. The model parameters have been calibrated to provide a reasonable representation of what future conditions might be if historic conditions repeat in the future; however, it is unlikely that this assumption would be met and thus, values presented in this report should be used for comparisons among alternatives only.

Figure 18: Cumulative Carson Division water rights distribution percentage from January through May (May C2) and January through June (June C2) used to index May and June C2 coefficients used in the Lahontan Reservoir Storage Equation.



GLOSSARY OF TERMS

Adaptive Management - Specific to wetland management, a program that allows for adjustments to be made to water management strategies, as necessary, to account for wetland habitat conditions at the beginning of a year and projected water availability for the remainder of the year in order to best meet refuge goals and objectives.

Deliverable Water - Any source of water that the Service can actively call on for delivery from Lahontan Reservoir. Examples include all acquired water rights and leased agricultural water rights. Deliverable water is generally prime water.

Drain Water - Water that enters wetlands through Newlands Project drains largely as a result of agricultural activities.

Full Water Year - Any year where a 100% allocation of water rights is anticipated and Lahontan Reservoir precautionary releases do not occur. Projected to occur in 13 of 20 years under 1997 OCAP assumptions

Groundwater - Water that must be pumped from below ground in order for it to enter the wetlands. For the purposes of this report, artesian wells are not considered a source of groundwater.

Incidental Flows - Any source of wetlands water that cannot be called upon for delivery and is thus, incidental to Newlands Project Operations. Drain water and spill water are examples of incidental flows.

Low Water Year - Any year where less than 100% receipt of Carson Division headgate entitlement occurs as a result of Lahontan Reservoir shortages. Projected to occur in 1 of 10 years under 1997 OCAP [7] assumptions

Prime Water - Water that is delivered to the wetlands directly from Lahontan Reservoir releases. Reused drainwater can be a deliverable water source but would not be considered prime water.

Spill Water - Water released from Lahontan Reservoir that exceeds the 295,000 acre-foot capacity of Lahontan Reservoir. Often referred to as precautionary release water, spill water is the amount which is not used in the Newlands Project to reflood canals and irrigation reservoirs nor used to irrigate Carson Division farms if the spill period falls within the irrigation season.

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[7] 1988 Newlands Project Operating Criteria and Procedures as amended (1997); 43 CFR Part 418

Spill Year - Any year where Carson River water flow amounts result in precautionary release of water from Lahontan Reservoir. It is assumed in spill years that the Service will generally not call upon acquired water rights until the spill period has concluded. This will ultimately result in the Service deviating from the modeled water allocation strategy to a more summer/fall based headgate delivery pattern. Projected to occur in 1 of 4 years under 1997 OCAP assumptions

Spring Pulse - a simulation of the natural hydrologic process of high spring flows, anticipated to move salts and other suspended solids from higher elevation wetland units to lower elevation wetland units. Spring pulses would only be used when the Service has 20,000 acre-feet or more of water available to call on in any given year.

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